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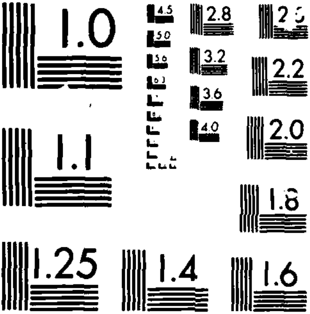


MICROCOPY CHART

# CENTERVILLE BEACH SPLIT PIPE REPAIR

## Ocean Engineering

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

CENTERVILLE BEACH SPLIT
PIPE REPAIR

1977

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A storm on the coast of northern California 1-10 March 1977 removed a significant amount of beach sand that was covering and protecting two 21 Q cables at the U.S. Naval FAcility, Centerville Beach. This report documents the total damage and the various repairs conducted on the systems.

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# CENTERVILLE BEACH SPLIT PIPE REPAIR

## INTRODUCTION

(U) A storm on the coast of northern California 1-10 March 1977 removed a significant amount of beach sand that was covering and protecting two 21 Q cables at the U.S. Naval Facility, Centerville Beach. See Figure 1. As a result it was discovered that several feet of split pipe and armor wire around the cable had been knocked off and worn away by heavy surf and that short sections of insulated conductors were exposed (Figure 2). This report documents the total damage and the various repairs conducted on the systems.

## BACKGROUND

(U) Naval Facility, Centerville Beach, California may be found on Department of Commerce, National Oceanographic and Atmospheric Administration, Coast and Geodetic Survey Chart 5602 (New #18620), "Point Arena to Trinidad Head" (Scale 1:200000). Facility is 13 nautical miles south of the entrance to Humboldt Bay and 8 miles north of Cape Mendocino. It is also shown on U.S. Geological Survey, Ferndale, California quadrangle map (Scale 1:24000) at 40° 34' North latitude and 124° 21' East longitude. The Facility is located five miles from Ferndale, the nearest town. The surrounding terrain is

Page 5 was intentionally left out of this report.
Per Mrs. Jacqueline B. Riley, NFEC/Chesapeake Division

3.

FIGURE 2. Damaged Cable exposed Insulated Conductors

hilly pasture with occasional clumps of evergreen trees. A rather steep mudstone slope three hundred feet high meets the sand beach one to two hundred feet from the water line. The slope stability is a matter of concern. Erosion and landslides are prevalent in the area. The beach continually changes. At one location four feet of sand was washed out overnight, exposing the underlying clay. Access to the beach is via a county park 0.6 miles north of the Facility. A LARC V may be driven between the guard posts separating the parking lot from the beach with several inches to spare on each side. The beach is open to civilian personnel. Fishermen, dune buggies, four wheel drive vehicles, and occasionally horses are encountered on the beach. The sand bottom slopes very gradually, normally producing four or five sets of breakers. Conducting LARC operations in surf greater than five feet is not recommended, as the breakers are too numerous and unpredictable to allow a safe exit from the water. The LARC V broaches easily in a following surf and would capsize should the wheels hit bottom while being swept to shore sideways.

ADMINISTRATIVE

(U) Upon being alerted to the cable damage, the Naval Electronics Systems Command requested that Chesapeake Division, Naval Facilities Engineering Command act as technical representative and that Underwater Construction Team Two serve as field repair agent for cable repair. This tasking is in

FIGURE 3. South Cable on Beach

FIGURE 4. South Cable D[illegible] [illegible]sposed Insulated Conductors

FIGURE 5. Small Cable Socket Cap Connection

Figure 6. North Cable on Beach

repair for such a total cable failure would have taken several months to perform.

(U) As an initial step it was decided to wrap the loose conductors in tape and then to reapply as much split pipe as possible. The WECO representative performed the cable wrapping, and members of the Naval Facility's Public Works Department applied the split pipe. This initial action along with daily inspection and maintenance of the cable protection proved to be successful in protecting the cables while preparations for the final repair were being made.

## THE REPAIR OPERATION

(U) As a more permanent repair, it was proposed to splice new cable around the damaged sections of both systems. Investigation of this proposal soon revealed that such a cable splicing operation would take nearly two months to prepare, including the fabrication and shipment of the required cable. Since any significant time delay could have caused an increase in the cable damage, the bypass splice had to be ruled out. It was therefore proposed jointly by UCT-2 and CHESNAVFACENGCOM that a modified application of the "Sea Form Systems" method (Appendix B) for pier piling protection be used. The "Sea Form" method was developed for protecting deteriorated pilings by incasing the piling in concrete. This system was adapted to protect the damaged cables. See Figure 7.

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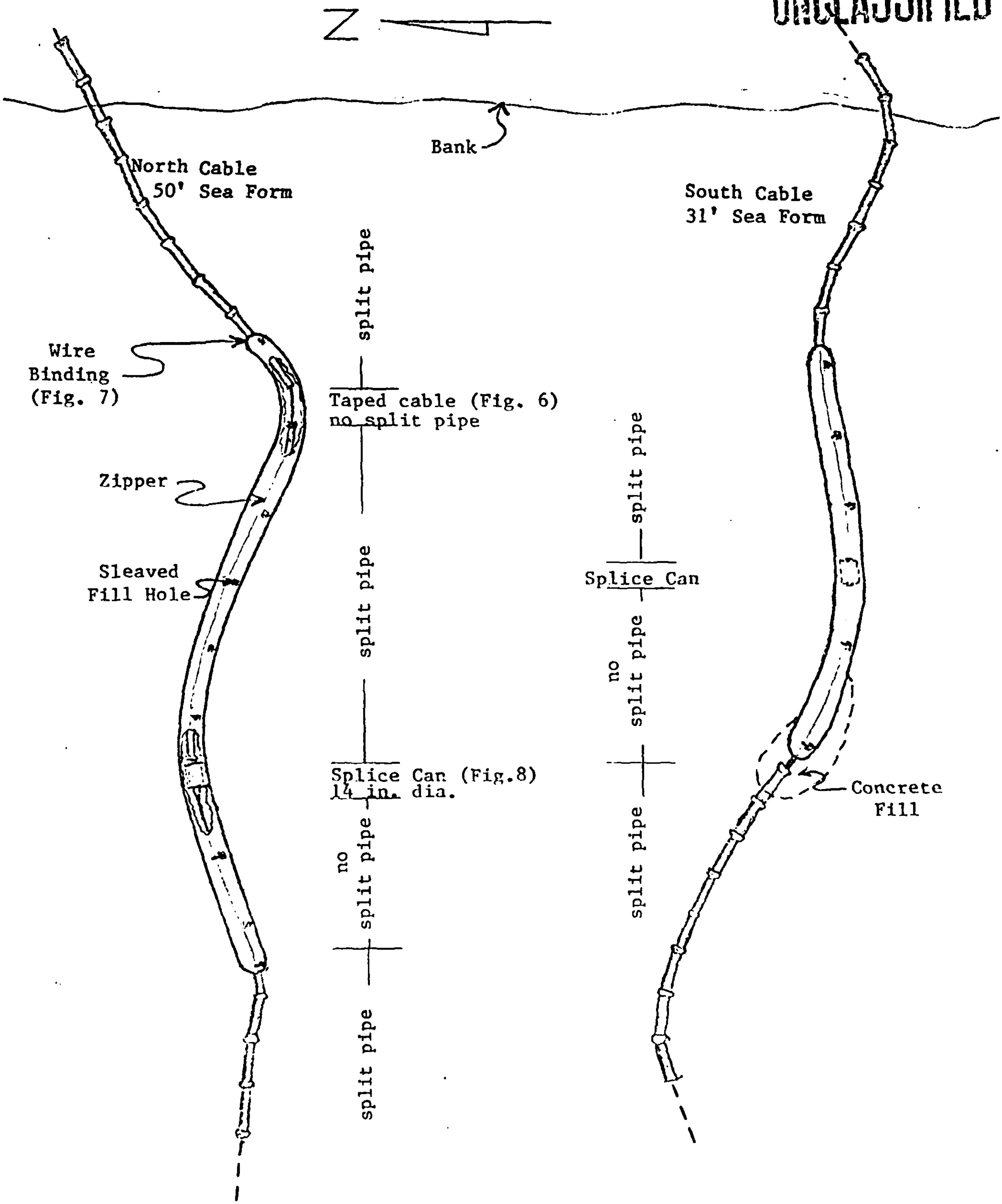



Figure 7. Cable Repair Layout

## RESTRAINTS

(U) Because of the unique requirements for this repair, conventional methods were not acceptable. The following is a list of the major restraints:

1. The repair had to be executed within one low tide cycle (5 hours).

2. All equipment and material had to be transported over a half-mile of sandy beach.

3. All equipment and material had to be immediately available, at or near the Naval Facility.

4. The cable could have been buried by sand or exposed. If covered, the cable must be uncovered.

5. The work had to be done with the personnel available and with no special training.

6. The repair had to be completed before the cable failed due to further surf action or was buried too deeply in the sand.

7. The cable could not be moved extensively because of its damaged condition.

(U) After the restraints had been defined the method developed to protect and stabilize the two cables required five basic operations:

(U) 1. The cables were first uncovered and a trench dug parallel to the cable for the form to settle in. The south cable, first to be done, was covered by 6-12 inches of sand for 75% of its length. A backhoe was used to uncover the cable and dig the trench parallel to the cable down to the mudstone on which the cable was laying. This phase took about one hour. The north cable was buried 3-4 feet under the sand for its whole length. This required that a dozer dig a 4 foot deep trench adjacent to the cable while the fire hoses were used to "jet" the sand away from the cable (Figure 8). The cable was then clear on both sides for the form to be applied. This phase of the operation took about 40 minutes.

(U) 2. Next, sections of the cable were lifted either by hand or with the backhoe while the wire mesh cage with the standoffs attached were fitted around the cable. The standoffs (rectangular plastic boxes) were stapled on the inside and outside circumference of the prefabricated steel cage in order to center the cable inside the cage and center the cage inside the nylon bag (Appendix B). Figure 9 shows the cable being lifted and the wire cage with standoffs being applied (note the taped section of cable). This phase of the operation took about 30 minutes per cable.

(U) 3. After the first cage was applied the nylon zippered bag was slid under the caged cable, the zipper started

[illegible] Cable [illegible]

Figure 9. Applying Wire Mesh Cage

and the end of the bag wired around the bell of a section of split pipe (Figure 10). As more sections of the cage were applied the bag was pulled under the cage and zipped closed (Figure 11). This phase took about 25 minutes for each cable. Concrete reinforcing bar (3/8 inch, 20 feet) was layed in the bag to improve the structural integrity of the form. Rebar stakes were driven through the bottom of each bag into mudstone as the bag was zipped up.

(U) 4. After the cage and bag were fitted around the cable concrete was pumped through nylon sleeved holes into the bag (Figure 12). As each section of the bag was filled, the hose was pulled out of the filling sleeve, pushed in the next sleeve, while the used sleeve was tied off with wire. The concrete was loaded from a commercial truck into the 1-yard bucket in the back of the 5-ton truck at the beach entrance parking lot. Then the 5-ton would drive the load to the work site (7 minutes roundtrip). One yard of concrete could be pumped into the bag in about four minutes. Both forms were 56 inches in circumference. The south cable was 31 feet long; took 3.5 yards of concrete and 40 minutes to fill. The north cable was 50 feet long; took 5 yards of concrete and 40 minutes to fill. The bag on the south cable was one split pipe section too short to reach the seaward leg of split pipe. Therefore, 0.5 cubic yards of concrete were poured around the seaward end of the form to structurally bridge the form to the split pipe (Figure 13).

Figure 10. Strapping the Pad to the Solid Pipe

Figure 11. [illegible]

Figure 12. Pumping Concrete into the Form

(U) 5. Finally, the form was buried; the south cable was buried by the dozer and the north cable was buried by the surf moving the sand.

AS COMPLETED

(U) The damaged sections of the two cables were successfully protected and stabilized using the "Sea Form System" to incase the vulnerable cable in concrete (Figure 7). Each repair section started out about 20 feet from the bank with the Sea Form nylon bag tied by wire around the bell of a split pipe section. The forms were 18 inches in diameter (56 inch circ.) with the cable centered inside. The splice cans connecting the shoreward and seaward legs of the cables were approximately in the middle of each form. Steel rebar was layed through the form to strengthen the form and rebar was driven through the bottom of the bag a few feet into the mudstone in order to anchor the form. Although the same system was used on both cables there were minor differences in what was installed.

(U) The south cable repair section was 31 feet long approximately 30 feet south of the north cable. The nylon bag was one split pipe section short of incasing the seaward leg of the split pipe (Figure 7). For this reason, 0.5 cubic yards of concrete were poured around the seaward end of the bag and cable to structurally bridge the form to the pipe. This cable was buried after the form was completely installed.

It has been observed that the concrete at the seaward end of the form had adhered to the nylon bag, thus successfully bridging the form to the split pipe seaward. See Figure 13.

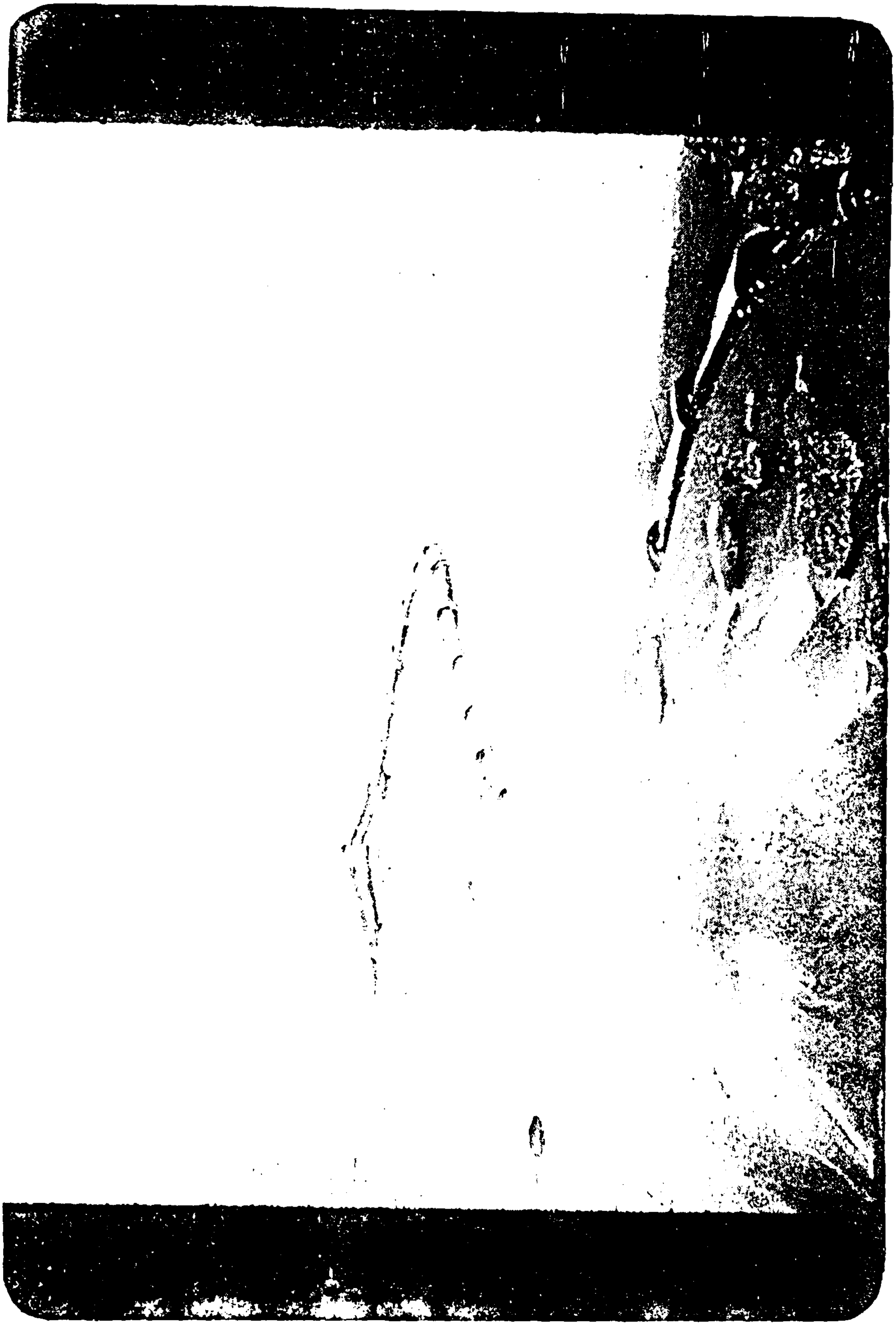
(U) The north cable repair was 50 feet long incasing both the seaward and shoreward legs of split pipes. There was a four foot section of taped cable (without split pipe) that was incased in the shoreward end of the form (Figure 7). This cable was left to be buried by the surf. See Figure 14.

(U) Daily inspection since the repair has shown that cables and forms are stable. The surf intermittently does uncover the form but no damage has resulted.

(U) Both cables are accumulating slack within the surf zone. Inspections of the cables have revealed that bends are being forced into the cables (split pipe) in the surf area 100-200 feet from the bank causing a section of pipe on each cable to split open and moderately kink the cable (Figure 15). More gradual bends have been pulled into the south cable in order to relieve the pressure on the kink and facilitate the tightening of the loose split pipe. The kinked section of north cable is too far into the surf zone to be immediately repaired. The condition does present a serious problem, and should be monitored by station forces.

## (U) LESSONS LEARNED

1. Sand tires were necessary for all the equipment that operated on the beach.



2. The fire hose worked very well for removing the beach sand. Specification as used:

Firehose - 800' @ 3" OD (Cotton)

200' @ 1-1/2" OD (Cotton)

Nozzle (2)

Y Gate - 3" to (2) 1-1/2"

Head - 45 psi @ hydrant

- 108 psi (250 feet vertical)

Volume used - 50,000 gal.

3. The trench dug by the dozer was necessary to provide the drainage away from the cable so the fire hoses could jet continuously.

4. The MAKO Grout Pump worked well and is recommended by Aquatic Marine Diver Inc. as the most reliable pump available.

5. The form should be filled from the low end first, filling uphill minimizes the losses due to voids.

6. The nylon bag should be pulled under the cable as the wire cage is applied.

7. The wire cage does not provide any structural strength to the form. Rebar should be used to provide the desired structural integrity.

8. Rebar should be driven through the bottom of the

bag into the ground to provide an anchor for the form.

9. The form should be vibrated to promote the filling of voids.

10. Water should be poured over the zipper to facilitate the removal of sand from the teeth of the zipper.

11. The backhoe was not efficient enough to unbury the cable buried in more than 12 inches of sand within the low tide cycle.

12. The backhoe had difficulty maneuvering on the beach due to poor traction in the sand. A tracked vehicle would have performed better.

13. The TM had to be backed up onto a low-boy trailer so the concrete could be gravity loaded from the TM into the bucket on the 5-ton.

14. The concrete bucket for hauling the concrete had to be blocked up so that the chute would fit under the bucket trap door and would gravity feed into the concrete pump.

15. The concrete does adhere well to the nylon bag.

16. The standard (Type 1) concrete mix with pea gravel aggregate was satisfactory for pumping. Extra water was used to facilitate pumping.

17. The MAKO Grout Pump is designed for 3/8 inch pea gravel; maximum 1/2 inch aggregate.

18. When tasking on an urgent, high priority job is sent, funds should be provided concurrently by the customer. Without ready, immediate access to funding, the repair team may not be financially able to respond.

# APPENDIX A

## EXPENSES

| | |
|---|---|
| U.S. Naval Facility | |
| Commercial contract | $6250 |
| Concrete | |
| Equipment rental | |
| Miscellaneous supplies | |
| UCT-2 | 2000 |
| Travel | |
| Per diem | |
| Miscellaneous supplies | |
| CHESDIV | 1750 |
| Travel | |
| Per diem | |
| Miscellaneous supplies | |
| Completion report | |

APPENDIX C

EQUIPMENT

| QUANTITY | DESCRIPTION |
|---|---|
| 1 | 5-ton, truck with sand tires |
| 1 | Jeep with sand tires |
| 1 | Lowboy with tractor |
| 1 | Bulldozer D-7 |
| 1 | Backhoe (John Deere) |
| 1 | Concrete Pump (MAKO) w/50' of hose |
| 1 | Hydraulic power source |
| 1 | Hydraulic impact wrench |
| 1 | Concrete bucket 1 yard |
| 1 | Pickup, 4x4, 6 pass |
| 1 | Acetylene cutting torch complete |
| 1 | LARC |
| 200' | Fire Hose @ 1-1/2" OD |
| 800" | Fire Hose @ 3" OD |

APPENDIX D

LOG

| | |
|---|---|
| 22 March | Low tide, 0700, south cable |
| 0500 | Muster |
| 0515 | Equipment headed for the beach |
| 0715 | First cage fitted on the cable |
| 0745 | Zippered bag pushed under the cage (31 ft) |
| 0800 | Drove stakes through the bag into the mudstone |
| 0845 | Form was complete |
| 0900 | First yard (load) of concrete pumped into the form |
| 0910 | Second yard of concrete pumped into the form |
| 0920 | Third yard pumped into form |
| 0930 | Fourth yard pumped into form |
| 0935 | Last half yard of concrete pumped around the seaward end of the form |
| 0955 | Last vehicle left work site |
| 1530 | Inspected the form after a high tide cycle. Form was 80-90% covered by sand and stable |
| 25 March | Low tide 0900, north cable, weather windy, 20K clear, 50°F. |
| 0530 | Muster |
| 0615 | Crews began to unbury the cable covered by 3-4 ft of sand using a dozer and fire hoses |

| | |
|---|---|
| 0655 | Cable completely uncovered |
| 0710 | Cable lifted by backhoe and first cage fitted over the shore end of the repair |
| 0720 | Zippered bag was fitted under the first cage |
| 0800 | Bag and cage completely installed |
| 0915 | First load of concrete arrived and pumping began |
| 0930 | First yard of concrete had been pumped into the form |
| 0940 | Second yard of concrete was pumped |
| 1005 | Fifth and last load was pumped into the bag |
| 1030 | Beach ops were secured |